User Manual

AES-MUX

Multichannel digital audio to fibre.

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0 Revision history

The latest version is always available in pdf-format on our web-site:

http://www.network-electronics.com/

Current revision of this document is the uppermost in the table below.

Revision	Replaces	Date	Change Description
A			Preliminary version.

Index

1 Introduction

The AES-MUX units actually consists of two or three modules in the Network Flashlink and Conquer series.

- The FRS-SDI frame synchroniser or LIS-SDI line synchroniser.
- The AV-MUX digital audio embedder.
- The AV-MUX-T digital audio embedder with optional single mode laser.

The AES-MUX4 is comprised of a synchroniser module and an AV-MUX. The AES-MUX8 is comprised of a synchroniser module and two AV-MUX modules.

The frame/line synchroniser is used to generate an SDI video signal which the AV-MUX cards embed up to 16 audio channels onto. The synchronisers can synchronise to either an SDI input or an analogue black+burst sync signal. The video channel may of course also be used as it is available on the receiver end. The AV-MUX cards will allow transparent transport of 24 bit AES audio if the source sample clocks are locked to the video signal supplied to the synchroniser. Sample rate converters will be automatically inserted if the audio is not isochronous, or if the synchroniser is not supplied with any signal. The nominal sample frequency is 48 kHz isochronous to the output SDI signal. The sample rate converted input signals will be present on the audio outputs of the AV-MUX cards.

The audio transport is a standard SDI video signal with embedded audio and may be decoded with any SDI de-embedder that follows SMPTE-S272M-A or C. The AV-DMUX modules are the ideal demultiplexer for digital audio but AAV-DMUX cards may also be used if an analogue signal is required. Both types of Flashlink DMUX cards have the optional optical receiver and an automatic switch between the electrical and optical inputs.

1.1 FRS-SDI

The ConQuer FRS-SDI frame synchroniser produces an SDI output with a constant delay relative to a black+burst signal. It may be used to delay a video signal up to 5 frames or produce an output signal with a constant phase relative to a reference.

The module is used in the AES-MUX to provide a carrier signal for the audio. It is recommended to connect the black+burst input to a house sync reference where one is available.

1.2 LIS-SDI

The ConQuer LIS-SDI line synchroniser produces an SDI output with a constant delay relative to a black+burst signal. The LIS-SDI de-glitches the digital signal when upstream switching is performed. It is possible to correct false F (Field), V (Vertical blanking) and H (Horisontal blanking) bits in TRS sync words. The LIS-SDI has an option to shift the whole video picture up and down with respect to the Vertical sync. The unit will always produce a valid SDI video signal even if there is no input.

The module is used in the AES-MUX to provide a carrier signal for the audio. It is recommended to connect the black+burst input to a house sync reference where one is available.

1.3 AV-MUX

The AV-MUX card is an eight audio channel, digital audio embedder and de-embedder card for serial digital video. It is one of the Flashlink series of modules, providing a compact and cost effective solution for the transport of digital video and audio over single mode optical fibre.

The card has a serial digital video input and a serial digital video output.

The AV-MUX card has four AES inputs and four AES outputs. The card may be used both as an embedder and a de-embedder. The card has two audio embedding processors, which can each process a group of four audio channels. This means the card can embed eight channels, de-embed eight channels or de-embed four channels and embed four channels. A more detailed description is given in the **configuration** section and the AV-MUX user manual.

1.4 AV-MUX-T

The AV-MUX-T is an AV-MUX module with the optional optical output. It is available with a variety of lasers as shown here:

-7.5 dBm output power:

- 1310nm

0 dBm output power:

- 1310 nm
- 1550 nm

0 dBm output power, ITU-T G.694.2 CWDM:

- 1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610nm

This corresponds to the Flashlink range of SDI-EO, electrical to optical converter cards.

2 Block diagram

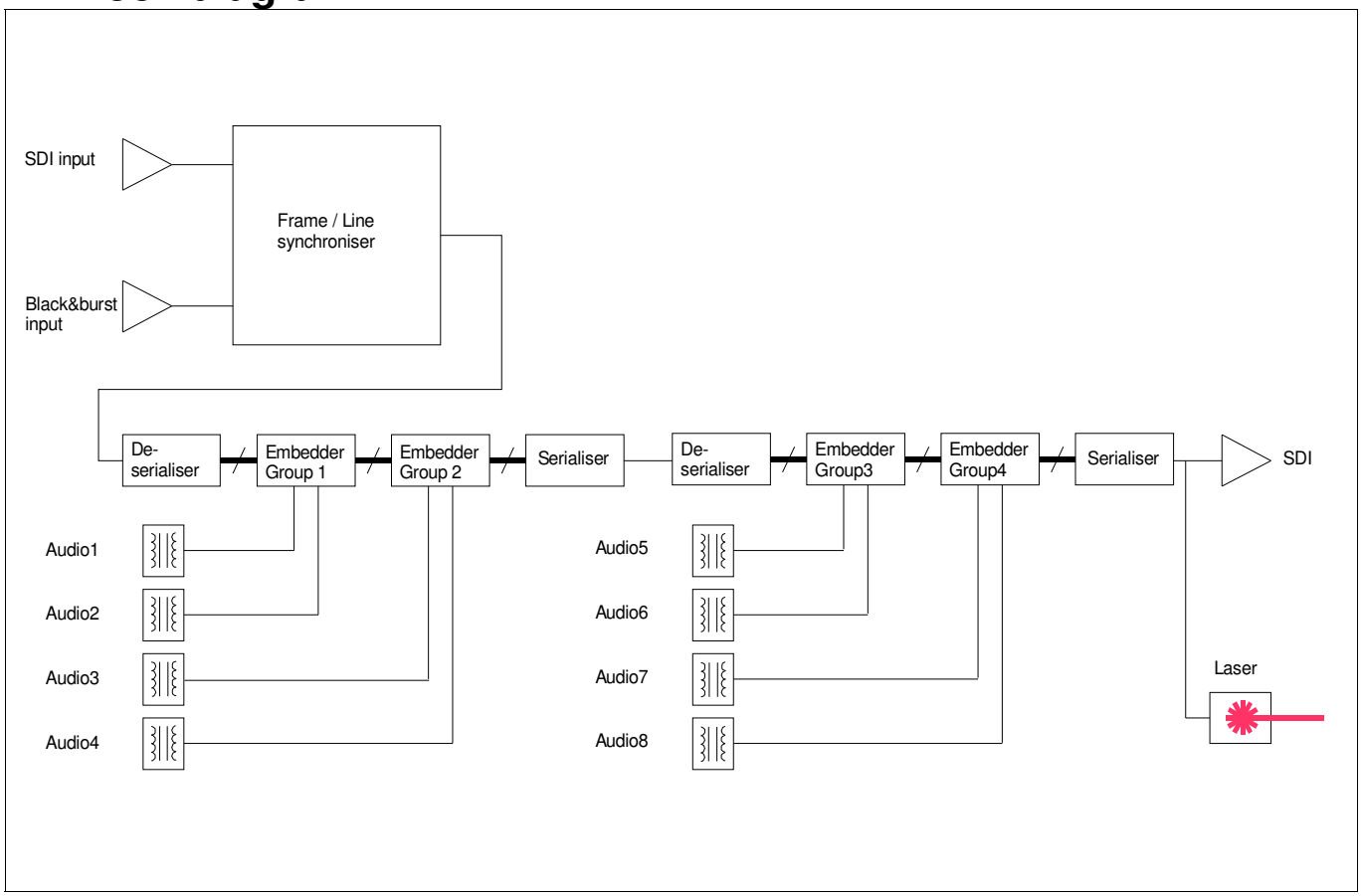

Figure 1 AES-MUX8 Block diagram

3 Configuration

The AES-MUX module combination is a special use of the modules and is configured for this from the factory. The modules may be reconfigured for specific requirements by the user. The standard factory configuration is the use of the AES-MUX as an audio transport and the DIP switches should be as follows:

Card	*Sw1*	*Sw2*	*Sw3*	*Sw4*	*Sw5*	*Sw6*	*Sw7*	*Sw8*	*Sw9*	*Sw10*
FRS-SDI	on		on							on
LIS-SDI	on		on	on						on

Synchroniser DIP switch settings

Card	*Sw1*	*Sw2*	*Sw3*	*Sw4*	*Sw5*	*Sw6*	*Sw7*	*Sw8*
AV-MUX	on	on		on				
AV-MUX-T	on	on	on	on	on			

AES-MUX8 AV-MUX DIP switch settings

Card	*Sw1*	*Sw2*	*Sw3*	*Sw4*	*Sw5*	*Sw6*	*Sw7*	*Sw8*
AV-MUX-T	on	on		on				

AES-MUX4 AV-MUX DIP switch settings

Only the switches in the on position are shown.

The configurations set the FRS/LIS-SDI as a signal generator that may be locked to a Black+Burst reference signal.

The AV-MUX cards are configured to embed audio on both groups. Groups 1 and 2 in the first AV-MUX card and groups 3 and 4 in the second (Only AES-MUX8). The audio signals will go through sample rate converters if they are not isochronous with the reference signal. Data signals such as dolby E or MPEG data may be transported transparently through the AES-MUX if the sample rate of the data stream is isochronous with the reference signal. The audio will be embedded with a 24 bit word length.

Other configurations may be realised and the configuration of the DIP switches is described below. See the module user manuals for a more detailed description.

3.1 FRS-SDI

3.1.1 DIP-switches

3.1.1.1 Switch 1 - Manual mode

Switch 1 is the manual mode switch. If on, the FRS-SDI is primarily assumed to be operated with switches alone. If off, the FRS-SDI is assumed to be used with a GYDA controller. Factory setting is switch 1 in off position. With switch 1 off, switches 2, and 3 do not have any effect. With switch 1 on the functionality of switches 2, and 3 is as follows:

3.1.1.2 Switch 2

Switch 2 turns on/off EDH in the output SDI. With switch 2 off, the EDH is included in the SDI signal. With switch 2 on, EDH is not included. Factory setting is switch 2 in off position.

3.1.1.3 Switch 3

Switch 3 sets the mode of the card when the input SDI signal disappears. With switch 3 off, the SDI output will freeze with the last valid video frame. With switch 3 on, the output signal will be blanked when the input SDI is not present.

3.1.1.4 Switches 4, 5, 6, 7 and 9 – Reserved

These switches are reserved for future expansion, and should always be in the off position. Factory setting is switch 5, 6, 7 and 9 in off position.

3.1.1.5 Switch 8 - Reset to factory default

FRS-SDI contains an EEPROM that is affected by any reconfiguration performed with GYDA. Switch 8 is used to reset the module to a known state.

3.1.1.6 Switch 10 - Programming mode

Switch 10 is purely used for service upgrade of the FRS-SDI firmware. It should always be in the on position. If switch 10 is in the off position, the 'Status' LED will light up red, and the FRS-SDI card will enter programming mode. This causes no harm, but the card will not work in this mode. Factory setting is switch 10 in on position.

3.1.2 Dials

The four dials are used to tell the module the delay of the output SDI signal, or the delay with respect to the reference signal. The maximum delay that can be configured manually is 5 frames 513 lines. The lowest dial sets 1-9 lines, the next 1-9 x 10 lines, the next, 1-9 x 100 lines and the top dial sets the number of frames.. The minimum signal delay through the unit is 2 lines

3.1.3 Buttons

Three buttons are present on the FRS-SDI. The button behind the dials at the lower front of the card is the reset button. Pressing this will produce the same result as removing and replacing the card. The two buttons behind the card ejector handle are used to adjust the phase of the output signal sample by sample. Adjustment is performed even if the card is not in manual mode.

3.2 LIS-SDI

3.2.1 DIP-switches

3.2.1.1 Switch 1 - Manual mode

Switch 1 is the manual mode switch. If on, the LIS-SDI is primarily assumed to be operated with switches alone. If off, the LIS-SDI is assumed to be used with a GYDA controller. Factory setting is switch 1 in off position. With switch 1 off, switches 2, and 3 do not have any effect. With switch 1 on the functionality of switches 2, and 3 is as follows:

3.2.1.2 Switch 2

Switch 2 turns on/off EDH in the output SDI. With switch 2 off, the EDH is included in the SDI signal, with switch 2 on, EDH is not included. Factory setting is switch 2 in off position.

3.2.1.3 Switch 3

Switch 3 sets the operating mode of the card, either de-glitching or line-sync mode.

- De-glitching: With switch 3 off, the video output is delayed half a line with respect to the first SDI input detected. The LIS-SDI tolerates upstream video switching on the input SDI. The de-glitching only works if the new SDI input signals have a phase difference not more than half a line from the first SDI input used.
- Line-sync: With switch 3 on, the output signal has a constant phase with respect to the Black+Burst input. This is called line-sync mode. The output delay/phase may be adjusted with respect to the reference but the total delay through the card must be between 41 samples and 1 line and 41 samples.

3.2.1.4 Switch 4

Switch 4 sets the TRS-Replace mode. With switch 4 off, the LIS-SDI is transparent to the video data. With switch 4 on the LIS-SDI will replace all the input SDI sync words with sync words generated by the internal video generator. This is a way to correct video that may have non-standard sync words. When both switch 3 and switch 4 are placed in the on position, it is possible to do a vertical shift of the video data with respect to the video sync words. Be careful. Audio and EDH information are also shifted. The LIS-SDI will generate a new EDH packet on the correct EDH line after the vertical shifting if switch 2 is off.

3.2.1.5 Switches 5, 6, 7 and 9 – Reserved

These switches are reserved for future expansion, and should always be in the off position. Factory setting is switch 5, 6, 7 and 9 in off position.

3.2.1.6 Switch 8 - Reset to factory default

LIS-SDI contains an EEPROM that is affected by any reconfiguration performed with GYDA. Switch 8 is used to reset the module to a known state.

3.2.1.7 Switch 10 - Programming mode

Switch 10 is purely used for service upgrade of the LIS-SDI firmware. It should always be in the on position. If switch 10 is in the off position, the 'Status' LED will light up red, and the LIS-SDI card will enter programming mode. This causes no harm, but the card will not work in this mode. Factory setting is switch 10 in on position.

3.2.2 Dials

The four dials are only used to tell the module the delay (in lines) of the output SDI signal with respect to the reference signal. Only the lower three dials are used so that the maximum delay that can be configured manually is 999 lines. The lowest dial sets 1-9 lines, the next 1-9 x 10 lines and the next, 1-9 x 100 lines. The maximum signal delay through the unit is 1 line and 41 samples so the acceptable phase of the input SDI signal is limited between 1 line, 41 samples to 41 samples before the output SDI signal. Vertical shift of the video signal may result if the input SDI signal is outside of this range.

3.2.3 Buttons

Three buttons are present on the LIS-SDI. The button behind the dials at the lower front of the card is the reset button. Pressing this will produce the same result as removing and replacing the card. The two buttons behind the card ejector handle are used to adjust the phase of the output signal sample by sample. Adjustment is performed even if the card is not in manual mode.

3.3 AV-MUX (-T)

Digital video may have up to four groups of four audio channels. An audio group has four audio channels. Each audio group contains two AES stereo audio signals. Each embedding processor works with a single audio group, so the AV-MUX card can work with two audio groups which are eight mono audio channels. The first embedding processor normally processes either group one, or group three. The second processor normally processes either group two, or group four. Embedded audio in video from digital VTRs is usually embedded in group 1. Embedding with group 1 with the AV-MUX is only used if the original audio is absent, or to be replaced.

NOTE! The AV-MUX removes all existing audio when embedding on group 1. Embedding on other audio groups appends the new group to existing embedded audio.

3.3.1 DIP switches

The configuration of the card sets a number of parameters: -

- The operational mode for each of the embedding processors, embedding or de-embedding.

- The audio group numbers being processed for each embedding processor.
- Whether the audio is removed.

3.3.1.1 OVERRIDE

The card is normally configured with switches on the front of the card and additional options may be controlled with the GYDA monitoring/ control card. The microcontroller on the AV-MUX card reads the DIP switches If the card configuration is changed with GYDA, the new configuration is stored on the card. The **OVERRIDE** switch must be in the off position if these changes are not be lost.

3.3.1.2 A Embed

This switch controls the audio direction in embedding processor A, to or from the video. Embedding processor A embeds audio when the switch is on and de-embeds audio when the switch is off.

3.3.1.3 A G3

This switch sets the audio group number for embedding processor A. Embedding processor A uses group 3 when the switch is on but uses group 1 if the switch is off.

Note: When the first processor A is configured to embed audio on group one, all existing ancillary data will be removed. The other embedding configurations will add new audio groups to the video signal.

3.3.1.4 B Embed

This switch controls the audio direction in embedding processor B, to or from the video. Embedding processor B embeds audio when the switch is on and de-embeds audio when the switch is off.

3.3.1.5 B G4

This switch sets the audio group number for embedding processor B. Embedding processor B uses group 4 when the switch is on but uses group 2 if the switch is off.

3.3.1.6 Unmarked or A&B Gn

This DIP switch may be used to assign the same group number to both embedder processors. This would be useful if the card is used as an add/ drop node, or for confidence monitoring. The group number is then set by the combination of the two group switches, as shown in the following table.

Group	*Switch A G3*	*Switch B G4*
1	off	off
2	On	off
3	off	On
4	On	On

Group assignment when both embedding processors use the same group.

3.3.1.7 Prog M

This switch is only used when programming the master microcontroller and must be switched off.

3.3.1.8 Prog S

This switch is only used when programming the slave microcontroller and must be switched off.

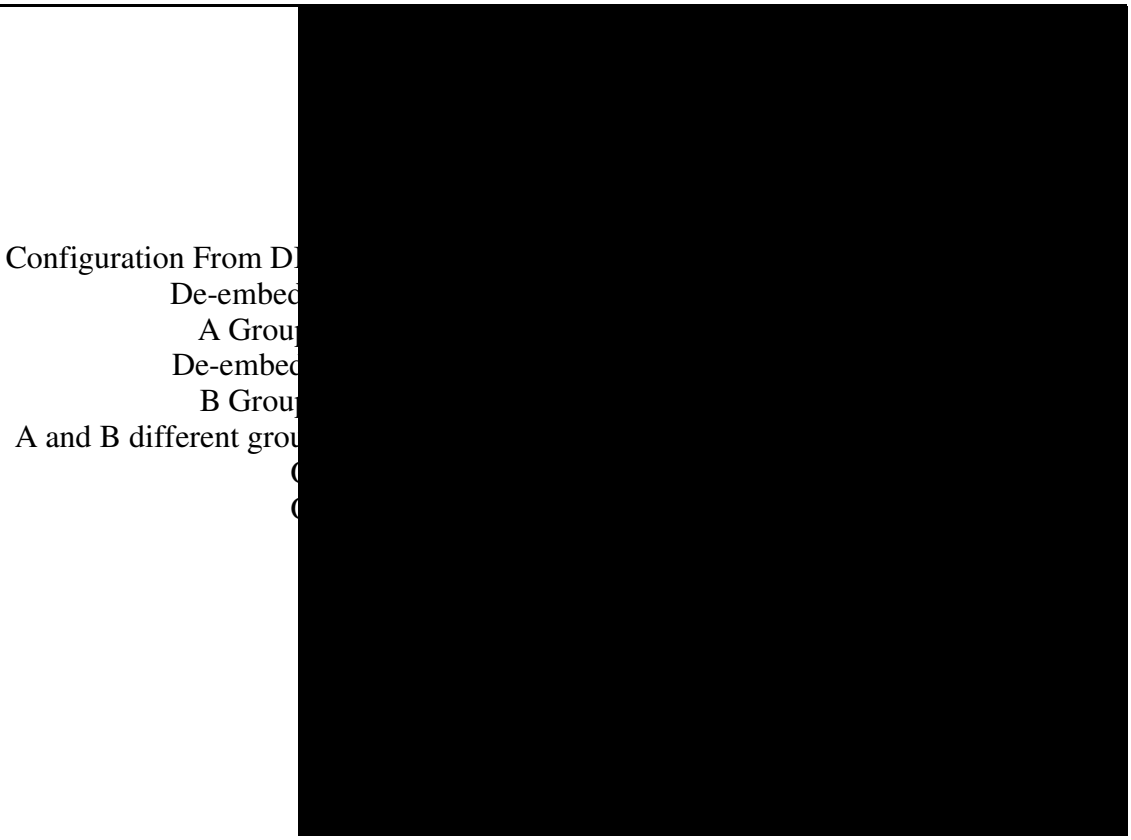

Figure 2 AV-MUX DIP switches configured to de-embed groups 1 and 2

4 Limitations

If the AV-MUX is used to embed in audio group 1, all existing packets will be removed.

The embedding processor does not read the any existing audio and begins to embed audio as soon as it finds any vacant space. It will embed an audio group 2 even if there is already one already present in the video. The result will be not be de-embedded correctly.

Removed audio groups when de-embedding will leave 'holes' in the embedded audio and the AV-MUX will start embedding as soon as any of these holes are encountered. This may result in the corruption of other audio groups which are still present after the 'holes'. This does not apply if Network embedding products were used to embed audio as they all use the same packet distribution.

5 Specification

5.1 General

Power:	+5V DC 2.5A 12.5W
Control:	DIP switches, Gyda system controller.
Monitoring:	Front panel LEDs and Gyda system controller .
EDH processing:	Full. Received flags are updated, new CRCs are calculated.
Embedding level SMPTE S272M (24 bit optional).	C Synchronous audio at 48 kHz and extended data packets
Embedded audio word length:	Configurable 24 bits or 20 (with Gyda).
Audio delay	1.6. ms

5.2 Inputs

5.2.1 Digital Video Input:

Video Data rate:	270Mbps or 540Mbps
Video frame rate:	50 Hz or 60 Hz.
Equalisation:	Automatic up to 35dB
Impedance:	75Ω
Return loss:	>15dB @270MHz
Signal level:	nominally 800mV
Connector:	BNC
Format:	ITU-R BT.601, SMPTE S259M

5.2.2 Black+Burst input

Input signal	PAL ITU-R BT.470-6 /NTSC SMPTE S170M
Return loss	> 35 dB up to 5.75 Mhz
Impedance:	75Ω
Connector:	BNC

5.2.3 Audio Inputs:

Number of digital inputs:	4 or 8
Differential Impedance:	110Ω transformer balanced or 75Ω unbalanced
Connector:	25 pin D-sub. or BNC
Maximum signal level:	7V
Minimum signal level:	200mV
Audio data rate:	16 kHz to 144 kHz, converted to 48 kHz if necessary.
Embedded audio word length:	20 or 24 bits.
Embedded audio Channel status:	As received when synchronous. Otherwise fixed.

5.3 Outputs

5.3.1 Audio Outputs:

Number of AES outputs:	4 or 8
Audio data rate:	48 kHz
Impedance (C1):	110Ω transformer balanced.
Connector (C1):	25 pin D-sub.
Impedance (C2):	75Ω unbalanced.
Connector (C2):	4 x BNC

5.3.2 SDI Output

Video Data rate:	270Mbps
Number of SDI outputs:	1
Connector:	BNC
Impedance:	75Ω
Return loss:	> 15dB @270MHz
Signal level:	nominal. 800mV.
Rise/fall time:	typically 650ps.

5.3.3 Optical Output

Transmission circuit fibre:	Single Mode
Light source:	F-P/DFB Laser
Optical wavelength (13T):	1310nm ±40nm
Optical power:	-7.5 dBm
Optical power (option):	0 dBm
Optical wavelength (15T):	1550nm ±40nm
Optical power:	0 dBm
Optical wavelength (C1nn0):	1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610nm ±6nm as per ITU-T G.694.2
Optical power:	0 dBm
Jitter (UI=unit interval):	Max. 0.135 UI
Return loss:	Typ. > 40 dB
Maximum reflected power:	4%
Connector:	SC/UPC

5.3.4 GPI

GPI FRS/LIS-SDI:	General error, SDI video error, Black + Burst error, EDH CRC error.
Maximum voltage:	30 V
Maximum current:	100 mA.
GPI Connector:	RJ45

Signal type:	Open collector transistor.
GPI AV-MUX:	Valid video, AES1 absent, AES2 absent, AES3 absent, AES4 absent.
Maximum voltage:	50 V
Maximum current:	400 mA if only one output driven, 100 mA all outputs driven.
GPI Connector:	RJ45
Signal type:	Open collector transistor.

6 Connector modules

6.1 FRS-SDI-C1

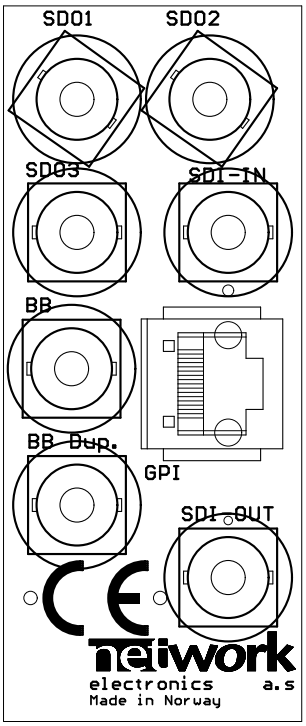

Figure 3 FRS-SDI-C1 Connector module.

6.2 AV-MUX-C1

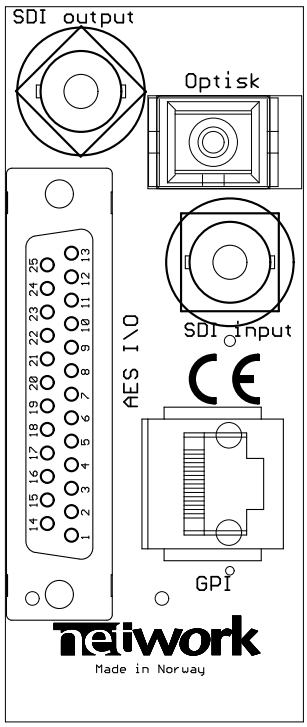

Figure 4 AV-MUX-C1 Connector module.

6.3 Mounting the connector module.

The backplanes will normally be installed side by side at the factory. The details of how the connector modules are mounted, can be found in the user manual for the sub-rack frame: FR-2RU-10-2.

This manual is available from our web site: http://www.network-electronics.com

6.4 Module interconnections

The SDO1 output from the FRS/LIS-SDI card must be connected to the AV-MUX input.

The SDI output of the first AV-MUX must be connected to the input of the second when present.

Patch cords for this purpose are supplied with the product.

6.5 Audio connections.

The AV-MUX-C1 connector card has a D-sub 25 pin connector for the audio signals. The pin configuration is similar to the TASCAM DA-88 connector . The configuration is shown in the figure below.

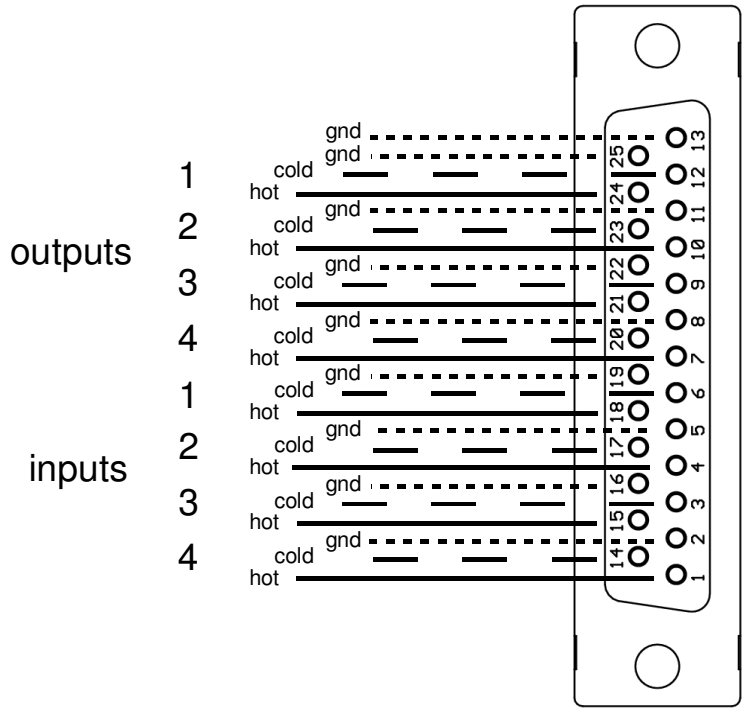

Figure 5 Audio connector configuration.

The AES-MUX 8 has 8 AES inputs and outputs. The first AV-MUX backplane has AES inputs 1 to 4 and the AV-MUX second backplane has AES inputs 5 to 8.

7 Operational status monitoring

The status of the modules can be monitored in three ways.

1. GYDA system controller module.
2. GPI at the rear of the sub-rack.
3. LED's at the front of the sub-rack.

Of these three, the GPI and the LED's are mounted on the module itself, whereas the GYDA-SC controller is a separate Flashlink module which presents the status of the Flashlink modules in the frame (s) as a web site.

The functions of the GPI and the LED's are described below.

7.1 GPI Module Status Outputs

These outputs can be used for wiring up alarms for third party control systems. The GPI outputs are open collector outputs, sinking to ground when an alarm is triggered.

The AV-MUX 'Valid video' is a positive signal so that a total loss of power will also trigger an alarm.

The other signals are triggered when the associated error occurs.

7.1.1 Electrical Maximums for GPI outputs

Max current: 100mA

Max voltage: 30V

7.1.2 FRS-SDI-C1 GPI pinning:

Signal	*Description*	*Pin #*	*Mode*
Status error	General error status for the module.	Pin 1	Open Collector
SDI input loss	SDI input loss	Pin 2	Open Collector
BB loss	Black+Burst not detected.	Pin 3	Open Collector
EDH error	EDH CRC error detected.	Pin 4	Open Collector
Ground	0 volt pin	Pin 8	0V

7.1.3 AV-MUX-C1 GPI pinning:

Signal	*Description*	*Pin #*	*Mode*
Valid video	Valid video is output from the card	Pin 1	Open Collector
AES 1 error	AES 1 receiver error	Pin 2	Open Collector
AES 2 error	AES 2 receiver error	Pin 3	Open Collector
AES 3 error	AES 3 receiver error	Pin 4	Open Collector
AES 4 error	AES 4 receiver error	Pin 5	Open Collector
Ground	0 volt pin	Pin 8	0V

7.2 Front Panel - Status Monitoring

The status of the module can be easily monitored visually by the LED's at the front of the module. The LED's are visible through the front panel as shown in the figure below.

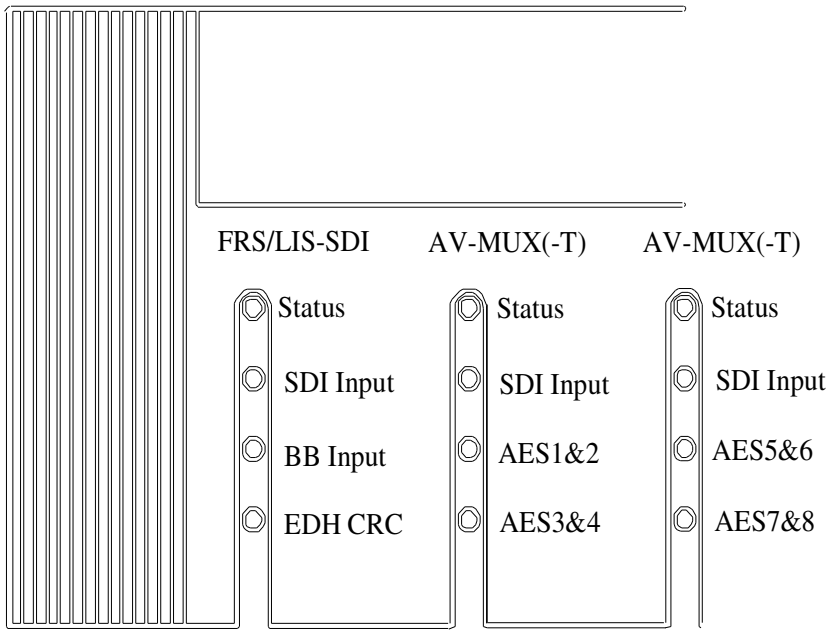

Figure 6 LED overview of AES-MUX8

(Text not printed on the front panel). Each module has 4 LED's. The colours of each of the LED's have different meanings as shown in the tables below.

7.2.1 FRS/LIS-SDI LEDs

Diode \ state	*Red LED*	*Orange LED*	*Green LED*	*No light*
Status	Major error. Remove the module.	Booting in progress	Module power is OK	Module has no power
SDI Input	SDI signal absent.	Weak signal detected	SDI signal present	
BB Input	Black+burst signal absent.	Signal detected but not locked	Black+burst signal present.	
SDI output status	Errors detected	n/a	No errors detected	

7.2.2 AV-MUX LEDs

Diode \ state	*Red LED*	*Orange LED*	*Green LED*	*No light*
Power status	Major error. Remove the module.	Module has not been programmed	Module power is OK	Module has no power
SDI input status	SDI signal absent.	n/a	SDI signal Present	
AES1&2 (5&6)	No signals detected	One signal detected	Both signals present	
AES3&4 (7&8)	No signals detected	One signal detected	Both signals present	

8 Laser safety precautions

Guidelines to limit hazards from laser exposure.

The AV-MUX units in the flashlink® range have a laser option.

Therefore this note on laser safety should be read thoroughly.

The lasers emit light at wavelengths around 1310 nm or 1550 nm. This means that the human eye cannot see the beam, and the blink reflex can not protect the eye. (The human eye can see light between 400 nm to 700 nm).

A laser beam can be harmful to the human eye (depending on laser power and exposure time). Therefore:

!! BE CAREFUL WHEN CONNECTING / DISCONNECTING FIBER PIGTAILS (ENDS).

NEVER LOOK DIRECTLY INTO THE PIGTAIL OF THE LASER/FIBER.NEVER USE MICROSCOPES, MAGNIFYING GLASSES OR EYE LOUPES TO LOOK INTO A FIBER END.USE LASER SAFETY GOGGLES BLOCKING LIGHT AT 1310 nm AND AT 1550 nm

Instruments exist to verify light output power: Power meters, IR-cards etc.

Flashlink® features:

All the laser module cards in the Flashlink® product range, are Class 1 laser products according to IEC 825-1 1993, and class I according to 21 CFR 1040.10 when used in normal operation.

More details can be found in the user manual for the FR-2RU-10-2 frame.

Maximum output power*: 5 mW. Operating wavelengths: > 1270 nm.

Max. power is for safety analysis only and does not represent device performance.

9 Declaration of conformity with CE

This apparatus meets the requirements of EN 55103-1 (November 1996) with regard to emissions, and EN 55103-2 (November 1996) with regard to immunity; it thereby complies with the Electromagnetic Compatibility Directive 89/336/EEC.

10 Environmental requirements for Network flashlink® equipment

1. The equipment will meet the guaranteed performance specification under the following environmental conditions:

- Operating room temperature range 0°C to 50°C
- Operating relative humidity range up to 90% (non-condensing)

2. The equipment will operate without damage under the following environmental conditions:

- Temperature range -10°C to 55°C
- Relative humidity range up to 95% (non-condensing)

3. Electromagnetic compatibility conditions:

- Emissions EN 55103-1 (Directive 89/336/EEC)
- Immunity EN 55103-2 (Directive 89/336/EEC)